U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

FINAL – FOR KATHY PERFETTI

Subject:	**OPERATIONAL APPROVAL FOR REQUIRED NAVIGATION PERFORMANCE AREA NAVIGATION (RNP RNAV)**	**Date: XX-XX-01** **Initiated By: AFS-400**	**AC 90-RNP RNAV**

1. PURPOSE. This advisory circular (AC) provides guidance material for the approval of Required Navigation Performance Area Navigation (RNP RNAV) operations. This AC is not mandatory and does not constitute a regulation. It is issued for guidance purposes and to outline a method of compliance for RNP RNAV operations. In lieu of following this method, operators may elect to follow an alternative method that has also been found acceptable by the Federal Aviation Administration (FAA). Operational approval for RNP-5 RNAV and RNP-1 RNAV based upon this AC satisfies the requirements for European BRNAV (RNP-5) and PRNAV (RNP-1) respectively.

2. RELATED REGULATIONS AND DOCUMENTS.

a. Title 14 of the Code of Federal Regulations (14 CFR): Parts 91, 121, 125, 129, and 135.

b. International Civil Aviation Organization (ICAO) Documents. Copies of the following ICAO documents may be obtained from ICAO, Document Sales Unit, 999 University Street, Montreal, Quebec, H3C 5H7, Canada; Tel.: (514) 954-8022; Fax: (514) 954-6769.

(1) Document 9613, Manual on Required Navigation Performance.

(2) Document 9689, Manual on Airspace Planning Methodology for the Determination of Separation Minima.

(3) Document 9750, Global Air Navigation Plan for CNS/ATM Systems.

c. RTCA, Inc. Documents. Copies of the following RTCA documents may be obtained from RTCA, Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, D.C., 20036-4001.

(1) DO-200A, Standards for Processing Aeronautical Data.

(2) DO-201A, User Recommendations for Aeronautical Information Services.

(3) DO-208, Minimum Operational Performance Standards for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS).

(4) DO-229, Minimum Operations Performance Standards: Wide Area Augmentation System

(5) DO-236A, Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation.

(6) DO-264, Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications.

d. FAA Technical Standard Orders (TSO). Copies of the following TSOs may be obtained from the U.S. Department of Transportation, Publications Department, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD, 20785.

(1) TSO-C115b, Airborne Area Navigation Equipment Using Multisensor Inputs.

(2) TSO-C129a, Airborne Supplemental Navigation Equipment Using the Global Positioning System (GPS).

(3) TSO-C146, Stand-Alone Airborne Navigation Equipment using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS).

e. FAA Orders. Copies of the following Orders may be purchased from the U.S. Department of Transportation, Publications Department, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD, 20785.

(1) Order 8400.12A, Required Navigation Performance 10 (RNP-10) Operational Approval.

(2) **(DRAFT)** Order 8260.RNP, Required Navigation Performance (RNP) Instrument Approach Procedures Construction.

f. FAA Advisory Circulars (AC). Copies of the following ACs may be obtained from the U.S. Department of Transportation, Publications Department, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD, 20785.

(1) AC 20-130A, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors.

(2 AC 20-138, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System.

(3) AC 120-70, Initial Air Carrier Operational Approval for Use of Digital Communication Systems.

(4) **(DRAFT)** AC 20-RNP, Airworthiness Approval of RNP RNAV Systems in the U.S.

(5) **(DRAFT)** AC 90-FPP, Development and Submission of Special Instrument Procedures to the FAA.

(6) AC 90-94, Guidelines for Using GPS Equipment for IFR En Route and Terminal Operations and for Nonprecision Instrument Approaches in the U.S. National Airspace System.

(7) (**DRAFT**) AC 90-45B, Operational Approval for Area Navigation (RNAV).

(8) AC 90-97, Use of Barometric Vertical Navigation (VNAV) for Instrument Approach Operations Using Decision Altitude.

3. DEFINITIONS.

a. Area Navigation (RNAV). A method of navigation that permits aircraft operation on any desired flight path.

b. Required Navigation Performance (RNP). A statement of the *navigation performance accuracy* necessary for operation within a defined airspace.

NOTE: There are additional requirements beyond navigation performance accuracy applied to a particular RNP type (Ref: ICAO Doc 9613).

c. Navigation Performance Accuracy. The total system error (TSE) allowed in the individual lateral and longitudinal dimensions. TSE in each dimension must not exceed the specified RNP type for 95% of the flight time on any portion of any single flight.

NOTE: There are additional requirements beyond accuracy applied to a particular RNP type (Ref: RTCA DO-236A and ICAO Doc 9613).

d. RNP Type. RNP types are established according to 95% navigational accuracy in the horizontal plane (lateral and longitudinal position fixing). The type is identified by an accuracy value expressed in nautical miles.

e. RNP RNAV Type. DO-236A uses the RNP types defined by the ICAO RNP Manual as the basis for establishing requirements. To accommodate the need for very accurate operations (e.g., instrument approaches), RTCA created another RNP RNAV type designated RNP <1 RNAV. This designator according to navigation performance accuracy in the horizontal plane, that is, lateral and longitudinal position fixing. This designator invokes all of the navigation performance requirements associated with the applicable RNP number, which is a containment value.

f. RNP and RNP RNAV Airspace. Area(s), route(s), or procedure(s) where minimum navigation performance requirements have been established and aircraft must meet those requirements while flying in the designated environment.

4. BACKGROUND. The continuing growth of aviation places increasing demands on airspace capacity and emphasizes the need for the best use of the available airspace. These factors, along with the enhanced accuracy of current navigation systems and the requirement for operational efficiency in terms of direct routings and track-keeping accuracy, have resulted in the concept of RNP.

Rapid changes in technology in the area of navigation performance, including the change from source- to earth-referenced systems, provides the foundation for aviation's global evolution. This progress will be marked by combining all elements of communication, navigation, and surveillance (CNS), and air traffic management (ATM) into tomorrow's CNS/ATM based systems. Concepts in CNS/ATM such as RNP provide the path for this transition.

a. Area Navigation (RNAV).

(1) RNAV is a method of navigation that permits aircraft operation on any desired flight path: e.g., "user preferred routes." The future CNS/ATM operating environment will be based on navigation defined by geographic fixes (latitude and longitude). Instrument procedures and flight routes will not require aircraft to overfly ground-based navigation aids (source-referenced systems) defining specific points.

(2) The application of RNAV techniques has been shown to provide a number of advantages over conventional forms of navigation, including:

(a) Establishment of more direct routes, resulting in shorter flight distances;

(b) Establishment of dual or parallel routes to accommodate a greater flow of en route traffic;

(c) Establishment of bypass routes for aircraft overflying high-density terminal areas;

(d) Establishment of alternatives or contingency routes, either planned or unplanned (e.g., severe weather avoidance); and

(e) Establishment of the best locations for holding patterns.

b. General RNP Concept.

(1) Required Navigation Performance (RNP) is a statement of the navigation performance accuracy necessary for operation within a defined airspace. The term RNP is also applied as a descriptor for airspace, routes, and procedures (including departures, arrivals, and instrument approach procedures (IAP)). The descriptor is flexible and can apply to a unique approach procedure or to a large region of airspace. RNP applies to navigation performance

within an airspace, and therefore includes the capability of both the available infrastructure (navigation aids) and the aircraft.

(2) RNP can include both performance and functional requirements, and is indicated by the RNP type as defined by ICAO Manual for Required Navigation Performance (Doc 9613) and RTCA DO-236A/EUROCAE ED-75A. RTCA DO-236A, Minimum Aviation System Performance Standards (MASPS): Required Navigation Performance for Area Navigation (RNP RNAV) contains system requirements for operations in an RNP RNAV environment. These standards are intended for designers, manufacturers, and installers of avionics equipment, as well as service providers and users of these systems for global operations. The MASPS provides guidance for the development of airspace and operational procedures needed to obtain the benefits of improved navigation capability.

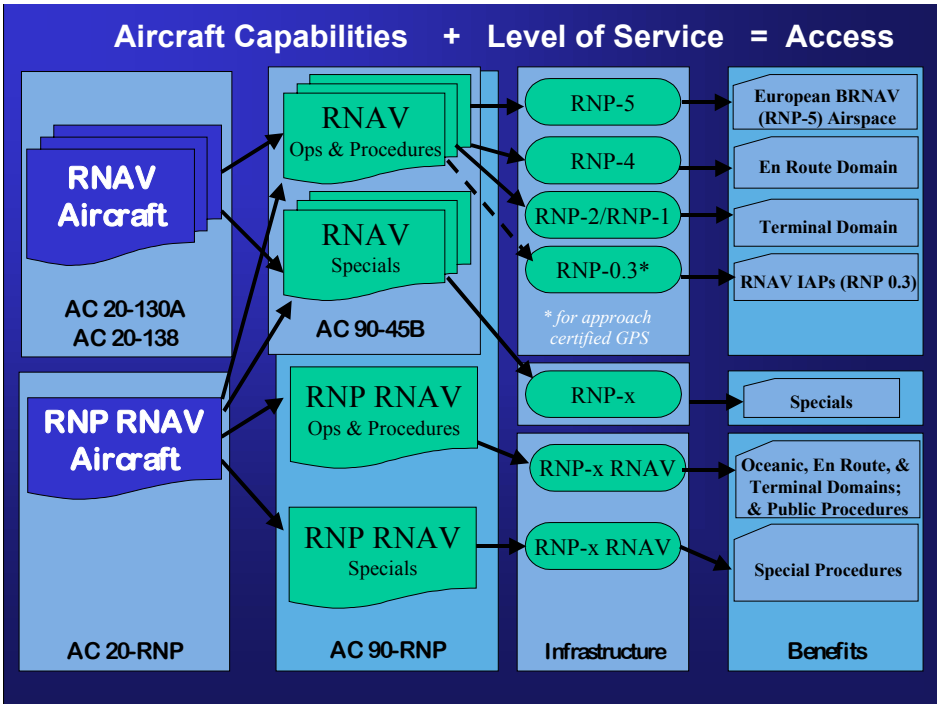
(3) RNP or RNP RNAV type is used to specify navigation requirements for the airspace. The required performance is obtained through a combination of aircraft capability and the level of service provided by the corresponding navigation infrastructure. From a broad perspective, the equation to be satisfied for the evolution to RNAV and RNP RNAV is as follows:

aircraft capability + level of service = access.

In this context, aircraft capability refers to the airworthiness, certification, and operational approval elements (including avionics, maintenance, database, human factors, pilot procedures, training, and other issues). The level of service element refers to the national airspace system infrastructure (including signal-in-space performance and availability; and air traffic management). When considered collectively, these elements result in providing access. Access provides the desired benefit (airspace, procedures, routes of flight, etc.).

RNP types specify the minimum navigation performance accuracy required in an airspace. Normally, aircraft not meeting the RNP type are excluded from RNP airspace (e.g. RNP 4 certified aircraft from RNP 1 airspace). If appropriately equipped, an aircraft with a level of navigation performance more accurate than that specified can fly in the airspace concerned (e.g. RNP 1 certified aircraft in RNP 4 airspace). *However, when an aircraft's level of navigation performance accuracy meets the requirements of a more stringent RNP airspace, based on the navigation aid (navaid) infrastructure, this capability might not meet the requirements of a less stringent RNP airspace due to the lack of supporting infrastructure appropriate to its navigation equipment fit,* e.g. RNP 1 (DME/DME only) certified aircraft is not capable of operation in RNP 10 (oceanic) airspace.

FIGURE 1. Evolutionary Path for Implementation



NOTE: Figure 1 shows how the elements of certification, operational approval, and infrastructure relate to benefits. The first column represents the airworthiness certification. The second column addresses the flight standards approval. Combining the first and second column collectively represent the aircraft capability component of the equation. The third column represents the level of service and the fourth column represents access. Precision approach operations are not addressed in this AC.

(4) Precision approaches are based upon specific sensors and not upon navigation performance for an operations/airspace. (See AC 120-29 and 120-28). The concept of RNAV is addressed in AC 90-45B.

c. RNP versus RNP RNAV (see RTCA DO-236A).

(1) It is important to distinguish between RNP and RNP RNAV operations.

(a) Where airspace is designated as RNP-x, the required performance is an accuracy value met by using an appropriate RNAV system. The accuracy requirement is that the total system error (TSE) does not exceed the specified RNP value ('x') for 95% of the flight time in either cross-track or along track.

(b) Where airspace is designated as RNP-x RNAV, performance requirements include containment (see Figures 2 and 3). Containment is a set of interrelated parameters used to define the performance of an RNP RNAV navigation system. These parameters are

containment integrity, containment continuity, and containment region. The accuracy requirement is the 95th percentile of TSE (same as RNP). Integrity and continuity are specified relative to a containment region, whose limit is equal to twice the RNP value (e.g., for RNP-0.3 RNAV the containment region is 0.6 NM). RNP RNAV has additional functional requirements beyond those of RNP, i.e., alerting of the loss of RNP capability must occur in the flight crew's primary field of view. Also, RNP RNAV avionics assume the ATS service provider ensures their navigation infrastructure meets desired performance requirements. These assumptions should be listed in the AFM. However, since all ATS service providers may not provide identical performance from their navigation infrastructure, the operator must ensure the service provider's existing infrastructure supports the desired RNP RNAV operation.

NOTE: At the time of publication of this AC, RTCA Special Committee-181 was at work defining criteria for RNP RNAV types less than RNP-0.3 RNAV. A future revision of this AC will include these criteria.

(2) The containment region (see Figure 3 below) represents an area where the navigation system provides assurance for its capability to monitor and detect lateral deviations beyond 2 x RNP. This means that the system will alert the flight crew when the navigation system does not comply with the containment integrity requirement of the current RNP RNAV type. This performance assurance is intended to facilitate the assessment of operational risk and safety for applications where ATC intervention is not feasible or timely (e.g., instrument procedure). The RNP RNAV containment region (the area defined by 2 times the RNP value) could help with safety assessments for separation and obstacle clearance in the development of routes, areas, and procedures.

NOTE: The use of buffer areas or secondary surfaces for RNP RNAV operations may be appropriate as determined by risk/safety analysis.

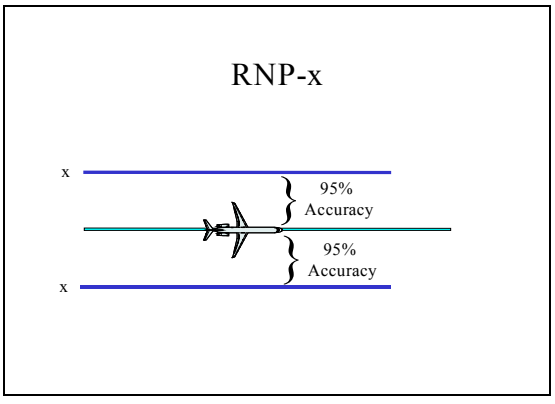


FIGURE 2. RNP

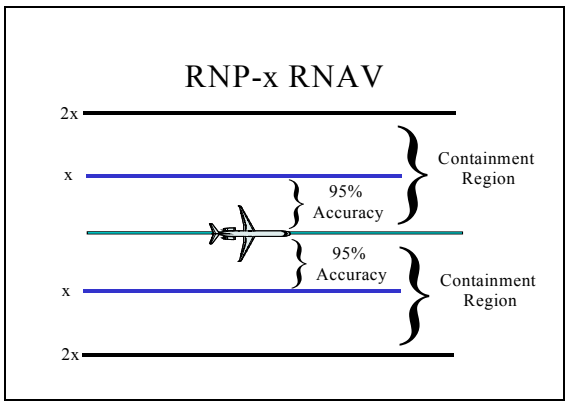


FIGURE 3. RNP RNAV

NOTE: Figure 2 depicts the lateral region defined by an RNP. Figure 3 depicts the lateral containment region for an RNP-x RNAV. Containment is not equal to obstacle/aircraft-to-aircraft separation.

(3) Containment integrity for RNP RNAV is the basis for user confidence in the correctness and reliability of the navigation capability including the monitoring and alerting for the RNP. The 2 x RNP containment limit represents a 99.999% per flight hour level of assurance that an undetected fault or condition leading to misleading RNP status has not occurred (e.g., aircraft is outside of 2 x RNP when indications are that it is within 2 x RNP, and no alert is issued).

(4) Containment continuity is the capability of the total system to satisfy the containment integrity requirement without unscheduled interruption during the intended operation. Containment continuity helps prevent unnecessary interruptions and false warnings of a loss of navigation capability.

The loss of all airborne navigation capability is classified as major, where the probability of loss is 0.001%. Where the airborne navigation system includes a capability for RNP RNAV operation, the probability of annunciated loss of RNP RNAV capability for an RNP type is 0.01%. The result of the annunciated loss is that the remaining navigation capability may be insufficient for the initiation or continued conduct of the RNP RNAV operation without a qualified alternative basis.

In the conduct of RNAV operations, specifically terminal and approach operations predicated upon an RNP RNAV capability, a continuity probability of 99.99% may also be inadequate in an obstacle rich environment. In such an ORE, this issue may be resolved by increased equipment redundancy/availability, operational performance requirements/limitations, or some other mitigation of risk. If no solution exists, these operations will be prohibited.

Note: Based upon their mean time between failure, many single system/sensor installations may not qualify for RNP RNAV operations when there is not an underlying navigation infrastructure available or when an ORE requires increased RNP RNAV containment continuity.

d. Standard RNP RNAV Types.

(1) Standard RNP RNAV types are generally associated with a type of operation. The operations identified in column 2 of Table 1 are not intended to limit other RNP RNAV types for that operation (e.g., RNP-1 RNAV may be used for en route operations). RNP RNAV types for public procedures are shown in Table 1. The latest version of AC 25.1309-1, System Design Analysis; AC 23.1309-1, Equipment, Systems, and Installations in Part 23 Airplanes; AC 27-1, Certification of Normal Category Rotorcraft; and AC 29-2, Certification of Transport Category Rotorcraft, provide a description of hazard classifications.

TABLE 1. STANDARD RNP RNAV TYPES

RNP RNAV Type	Applicability/ Typical Operation	Normal Performance 95% Accuracy	Airborne Containment Region	Hazard Class (Misleading Information/Loss of Navigation) Note [2]
RNP – 2 RNAV	En route	2 NM	+/- 4 NM	Major / Minor[3]
RNP – 1 RNAV Note 1	Terminal Area	1 NM	+/- 2 NM	Major / Minor[3]
RNP - 0.3 RNAV	Approach	0.3 NM	+/- 0.6 NM	Major / Minor[3]

NOTE 1: RNP-1 RNAV applies when conducting a published Departure Procedure (DP), Standard Terminal Arrival (STAR), Missed Approach Procedure, and for segments of an IAP prior to the final approach segment.

NOTE 2: Determination of the hazard classification is dependent upon the TERPS obstacle clearance surface and assumes use of a Collision Risk Model to achieve the Target Level of Safety. These failure classifications with their associated design assurance levels may not be adequate for an Obstacle Rich Environment (ORE). An ORE would require other risk mitigation techniques, special equipment, and special authorization. "An environment is obstacle rich when is it not possible to construct an unguided, discontinued approach using procedural means." [Reference: RTCA DO-264.] Approach operations in an ORE require supplemental guidance to assure an appropriate routing for a climb to minimum vectoring altitude or minimum IFR altitude, whichever is lower.

Special procedures may require additional risk mitigation techniques that are not applicable to public procedures. The missed approach/aircraft extraction must be evaluated for operational approval.

NOTE 3: Typically, loss of RNP has a minor hazard effect. However, a loss of *all* navigation capability creates a major hazard effect. Analysis of the supporting infrastructure and/or availability of specific navigation systems are critical to this assessment.

(2) In addition to these RNP RNAV types, other RNP RNAV types may be supported on a case-by-case basis. For RNP RNAV types less than RNP-0.3 RNAV refer to section 6, Special Procedures.

(3) Given these RNP RNAV types, certain types of RNP RNAV equipment will utilize default RNP RNAV types dependent upon phase of flight. For example, Wide Area Augmentation System (WAAS) stand-alone navigation units (TSO-C146) support operations for standard RNP RNAV types of 2, 1, and 0.3. This allows WAAS to satisfy the RNP RNAV requirements without having to impose unique operational issues and/or procedures on the equipment and users of that equipment.

e. Application of RNP RNAV – Airspace Design.

NOTE: RNP is a navigation requirement and is only one factor to be used in the determination of required separation minima. RNP alone cannot and should not imply or express any separation standard or minima.

(1) When establishing air traffic route spacing and aircraft separation minima, in addition to the navigation element, one must also considers the supporting airspace infrastructure, including surveillance and communications. Additionally, the parameters of Air Traffic Management, such as intervention capability, capacity, airspace structure, and occupancy or passing frequency (exposure) must be evaluated. A general methodology for determining separation minima has been developed by the ICAO (see Document 9689). The general methodology is to conduct an operational safety assessment that considers all CNS/ATM elements.

NOTE: See RTCA DO-264 for a description of the Operational Safety Analysis (OSA) and an example of a specific element (Communications). Separation minima associated with a given RNP or RNP RNAV type may therefore vary, dependent upon other factors considered during the OSA.

(2) Near-term implementation of RNP RNAV includes RNAV instrument approach procedures for GPS or DME/DME RNP-0.3 RNAV certified aircraft.

f. Principles of RNP Implementation

(1) RNAV and RNP RNAV operations are multiple-choice-sensor-specific. RNP RNAV is not sensor independent as the foundation for access includes the aircraft capabilities and the level of service provided by the NAS.

While it has been a goal for RNP to be sensor-generic, this goal is unachievable as long as the aircraft capability is in any way dependent on external signals. The aircraft navigation system always consists of specific sensors or sensor combinations and the navigation infrastructure consists of specific systems. In addition, flight inspection and maintenance personnel ensure the quality of specific navigation systems. Sensor independent operations (where pilot does not have to be concerned about what sensors are being used) could be established when the airborne equipment provides the protections and system alerting based upon specific navigation systems.

(2) The sensor-specific options available for any given route, procedure or airspace depend on the available infrastructure (level of service) and the requirements (aircraft capabilities) that promote access to a given airspace or procedure.

For example, a DME/VOR system may be capable of RNP-4 operations, but would not be capable of conducting RNP-4 operation in the Pacific.

(3) For instrument approach procedures, the FAA is supporting the following sensor-specific combinations:

- GPS
- GPS/inertial
- DME/DME/inertial

These sensor combinations have been identified as being most likely to support the desired RNP value (RNP-0.3), as well as being prevalent in all RNP-certified aircraft. Special procedures may be authorized for RNP values less than 0.3. RTCA SC-181 is currently evaluating such low RNP values.

(4) As part of pre-flight planning, the operator must review all NOTAMs pertinent to the intended route of flight (including operations/procedures requiring an RNP type) and determine if there is an expected impact to his navigation capability.

This function must be accomplished to preclude operators from dispatching into areas where there is a known navigation outage that would affect their flight plan. It is analogous to the use of NOTAMs today, except the mapping from a facility outage to the operational impact of the outage is not necessarily obvious. For example, the operational impact of a GPS satellite outage can only be determined through modeling. The same effect can occur due to DME outages.

(5) During flight, the pilot must be able to assess the navigation capability of the aircraft on any future part of the flight plan, in response to aircraft equipment failures or ground infrastructure failures.

Note: Since the estimation of the navigation position may use sensors/navaids not directly associated with an operation, it is often not obvious to the pilot what impact a navaid outage will have on an RNP operation. With this uncertainty on whether an RNP capability will exist on any future part of the flight plan, it becomes necessary for the service providers to establish routes and procedures based on minimum equipment capability and to ensure that the infrastructure supports an RNP type based upon specific navigation systems. For those aircraft/operators wanting to operate outside of the supported infrastructure they will need to provide these in-flight assessment tools.

This function must be available to support in-flight decision-making. For example, if GPS is the RNP-0.3 system and your GPS receiver(s) fail en route, alternate plans for an approach capability may have to be made. A similar function is currently provided for the ground infrastructure, through the use of ATIS.

(6) Effective air traffic management will require automation to assist the controller in assessing the operational impact of a ground infrastructure failure.

In the unlikely event that there is an outage that affects multiple aircraft (e.g., GPS interference or failure of a critical DME), ATC may require the ability to rapidly assess the operational capability of aircraft in order to optimize the flow of air traffic.

5. OPERATIONAL APPROVAL FOR RNP RNAV OPERATIONS.

a. Air Carrier/Commercial Operator Approval. Operators seeking RNP operational approval should notify the Certificate Management Office (CMO) or certificate-holding district office (CHDO) which holds their air carrier or operating certificate of their intent. Appendix 1 contains the requirements for obtaining operational approval for RNP RNAV operations. Upon satisfactory completion of the evaluation, RNP RNAV authorizations will be addressed through issuance of approved Operations Specifications (OpSpecs) that will identify any conditions or limitations necessary (e.g., navigation systems or procedures required, routes, areas, procedures authorized). The MEL must address equipment that is required to achieve and maintain RNP RNAV operations. Operational approval under this AC meets or exceeds the requirements of AC 90-45B.

Note: For example, often the lower RNP types will require FD/AP coupling or GPS as the navigation sensor in order to achieve the required navigation performance. These items are then necessary MEL dispatch items for operations based upon these types.

b. Air Carrier/Commercial Operator Approval Process. FAA Order 8400.10, Air Transportation Operations Inspector's Handbook, volume 3, chapter 9, contains instructions for conducting the validation test process. Validation tests are conducted when an applicant is required to demonstrate its capability to conduct operations over proposed routes or areas in compliance with regulatory requirements before being granted FAA authorization to conduct these operations. The five-phase process for obtaining operational approval for RNP RNAV operations follows:

(1) Phase one of the approval process begins when an applicant requests authorization from the FAA. The FAA and the applicant must reach a common understanding of what actions must be completed, what role the FAA will have, and what reports and documents must be prepared as part of the approval process.

(a) The applicant will state its intention to include, at a minimum, the type of operation requested, type equipment planned for use, and any previous experience with this type of operation.

(b) The FAA will organize a test team, initiate preliminary coordination, and become familiar with the applicant's manuals, procedures, and policies.

(2) Phase two begins when the applicant submits an application package to the FAA for evaluation. During this phase, the FAA must ensure that the application package is complete and in an acceptable format before a thorough review and analysis can be conducted.

(a) The applicant will submit an application package which will include, as a minimum, the operator's aircraft eligibility documentation, continued airworthiness program, crew qualification and training, operating procedures, manual revisions, Minimum Equipment List (MEL), and validation test plan. (See Appendix 1 for the contents of the application package.)

(b) The FAA will determine if the application package is complete and in an acceptable format.

(3) Phase three begins when the FAA starts an in-depth review and analysis of the application package for: regulatory compliance, safe operating procedures (as described in approved manuals), logic of sequence, and other areas (e.g., training programs, flightcrew and dispatcher qualifications, flight following requirements, acceptable participants, schedules).

(a) The FAA evaluates all submissions. If incomplete or unacceptable, the FAA will return the application package to the applicant for corrections. If complete and acceptable, the FAA plans and coordinates with the applicant any demonstrations that will be conducted in phase four.

(b) The applicant makes corrections to its submission if required and coordinates phase four activities with the FAA.

(4) Phase four is the major phase of the validation process. For validation testing, the applicant will conduct specific operations to collect data for either validation or FAA observation purposes. This phase is concluded when the applicant either provides proof that satisfies the FAA's requirement that all test objectives are met or is unable to complete them satisfactorily.

(a) The applicant will demonstrate its ability to conduct the RNP RNAV operations.

(b) The FAA will determine that the applicant has satisfied the test objectives or that the applicant is unable to complete them satisfactorily.

(5) Phase five begins after the successful completion or termination of the validation test process. In this phase, the FAA grants approval to the applicant that satisfactorily completes the validation test process or does not grant approval to the applicant that does not satisfactorily complete the validation test process.

(a) The FAA either grants approval and issues the appropriate OpSpecs or sends a letter of disapproval to the applicant.

(b) The applicant begins RNP RNAV operations upon receipt of appropriate OpSpecs.

c. Part 91 Operators. Under 14 CFR Part 91, operators must fulfill the responsibilities covered under section 91.3 for aircraft operations. Part 91 operators need to prove that RNP

RNAV operations will be conducted in accordance with this AC, and that aircraft system eligibility per **(DRAFT)** AC 20-RNP has been established before beginning to conduct RNP RNAV operations (see Appendix 2). Operators should contact their FSDO for questions. Part 91 operators who comply under aircraft eligibility based on **(DRAFT)** AC 20-RNP or AC 20-138, with a GPS/WAAS stand-alone panel-mount unit (TSO-C146), should review their Airplane Flight Manual (AFM) or AFM supplement to determine the basis for their navigation system eligibility.

NOTE: TSO-C129 equipment does not satisfy the requirements for RNP RNAV operations. TSO-C129 is appropriate for specific operations where the use of GPS is authorized (e.g., RNAV (GPS) procedures).

(1) Aircraft with Flight Management System (FMS) installations that meet the certification requirements of **(DRAFT)** AC 20-RNP are capable of RNP RNAV operations. (See Appendix 1, Aircraft Eligibility Documentation Section, for further guidance.)

(2) Those Part 91 operators that have FMS installations that do not meet the criteria defined in **(DRAFT)** AC 20-RNP should contact their local Flight Standards District Office (FSDO) to determine the specific capabilities of their aircraft.

(3) Procedures and operating limitations, as well as equipment requirements, should be specified in the AFM.

(4) RNP RNAV operations require a current aeronautical database.

6. SPECIAL PROCEDURES.

a. Users can demonstrate the ability to conduct operations to other than standard RNP RNAV types (e.g., less than RNP-0.3 RNAV) and the use of other than published TERPS criteria. Risk mitigation must provide an equivalent level of safety for such operations. Mitigation techniques could include the use of other systems or special training/proficiency requirements.

b. Requests for special procedures will be handled on a case-by-case basis. Applicants must prove their equipment is capable to operate to the specific standards required and should submit proposed procedure development criteria for such operations. Aircraft Certification (AIR) and Flight Standards (AFS) will review the proposal and determine whether these operations can be conducted. (See (DRAFT) AC 90-FPP for guidance.)

(1) The operator submits documentation of its proposed operation to its CHDO or local FSDO. After local review, the request is forwarded to the appropriate FAA regional office. The region will review and forward the package with comments/concurrence to the Flight Technologies and Procedures Division, AFS-400. AFS-400 will coordinate review of the package with the Continuous Airworthiness Maintenance Division, AFS-300. The package should include, as a minimum, the following:

(a) Aircraft eligibility documentation — AFM, AFM supplement, or other official documentation that establishes aircraft qualification. The operator should provide evidence that the proposed navigation system is certified for the type of operation. (This determination should be coordinated closely with the principal avionics inspector.) RNP RNAV systems should reflect a statement that the system meets the reliability and performance criteria contained in established certification requirements. (See Appendix 1 for additional information on aircraft eligibility documentation.) The AFM should also document or reference the list of assumptions external to the aircraft upon which compliance is based.

(b) Type of aircraft and description of aircraft equipment to be used (including additional equipment like Terrain Awareness and Warning System (TAWS)). Provide a configuration list that details pertinent components and equipment to be used for the operation.

(c) A description of the specific operation requested and an operational safety assessment providing the rationale and basis for the proposed special operation.

(d) A sample of the approach plate to be developed with a statement of operational requirements, to include the proposed criteria, for the instrument procedure. The statement is dependent upon specific applications used for risk mitigation.

(e) Operating procedures and practices, including procedures to mitigate risk (e.g., wind limitations). Company manuals must adequately address the special characteristics of a proposed area of operation and the operational (navigation) practices and procedures that must be used. Part 91 operators should confirm they will be operating using procedures and practices identified.

(f) Database integrity — the procedures used to assure the integrity of the waypoints contained in the database being used for the proposed operation. Refer to Appendix 1, Item 4a for database requirements. Changes to the database format such as ARINC 424 changes must be reviewed for potential impact the change will have on current operations. Paper and/or electronic charts should be available to the flight crew to mitigate any discrepancies or missing data in the database.

Note: Aircraft certification is treating changes in the database formatting as the same as changes in the component software.

(g) Flightcrew training programs. Operators should submit training syllabi and other appropriate material to show that operations are incorporated into their programs. Training programs must adequately address the special characteristics of a proposed area of operation and the operational (navigation) practices and procedures that must be used. Currency for special RNP RNAV procedures may be required for flight crewmembers, e.g., every 90 days.

(h) Operations manuals and checklists. Operators should submit manuals and checklists that include information/guidance to be used for specific operations requested. Part 91 operators should submit AFMs and required supplements for the aircraft to be used in the operation.

(i) Simulator training. Operators should submit a description of the training to be conducted using simulation, credit given for simulation, and how this training is used for line pilot qualification.

(j) Maintenance program. The operator should submit a maintenance program that includes instructions for continued airworthiness of the equipment/systems to be used in the operation and required training for maintenance personnel.

(k) Historical data (data collection). A method to collect data on the successful and unsuccessful attempts to conduct the operation. Each operation should be recorded, and unsuccessful attempts should include the factors that prevented successful completion of the operation.

(l) MEL. The operator should submit any revisions to the MEL necessary for the conduct of the operation.

(m) Validation. The operator should submit a validation test plan to show the operator is capable of the requested operation. (See Order 8400.10, chapter 9, for guidance and requirements of validation tests.)

(n) Proposed language, e.g. non-standard OpsSpecs, that identifies any conditions or limitations necessary or required for the authorization.

(o) Proposed instrument procedure packages must include a plan by which the operator/proponent intends to satisfy the requirements of flight inspection, Notice to Airmen (NOTAMs), environmental study, procedure maintenance, and obstacle evaluation (OE).

(2) FAA Review and Evaluation of Applications.

(a) Once the application has been submitted, the FAA will begin the process of review and evaluation. If the content of the application is insufficient, the FAA will request additional information from the operator. When all airworthiness and operational requirements of the application are met, the FAA will issue the appropriate approval authorization as well as procedure/criteria approval.

(b) A list of operators and locations for special operational approval/relevant OpSpecs will be maintained in the operational specification subsystem.

7. TRAINING.

a. General. Operators and organizations should provide adequate training for key personnel (e.g., flightcrews and dispatchers) in the use and application of RNP RNAV procedures. A thorough understanding of these operational procedures is critical to the safe operation of aircraft. This training should be accomplished in accordance with the information provided by this AC and the associated reference materials.

b. Flightcrew Training.

(1) Each operator is responsible for the training of flightcrews to the applicable level of RNP RNAV operations exercised by the operator. The operator should include training on the use of navigation and other equipment during RNP RNAV operations and discuss RNP RNAV regulatory requirements and procedures. These requirements must be included in the operator's flight operations and training manuals (as applicable).

(2) This material should adequately cover all aspects of the operator's RNP RNAV operations and its FAA OpSpecs, as applicable. Individuals should be thoroughly familiar with this training material before engaging in RNP RNAV operations.

c. Part 121 & 135 Flightcrew Qualification Training.

(1) General.

(a) RNP RNAV Issues and Objectives. Air carriers should address the following training and qualification issues and objectives to ensure appropriate flightcrew RNP RNAV qualification:

1. Provide flightcrew knowledge of RNP RNAV concepts, systems, and procedures (RNP RNAV Academic Training).

2. Develop flightcrew knowledge and skills necessary to properly conduct RNP RNAV operations (RNP RNAV Procedure Training).

3. Assess each pilot's ability to properly use RNP RNAV (RNP RNAV Initial Evaluation).

4. Maintain appropriate flightcrew RNP RNAV knowledge and skills (RNP RNAV Recurrent Qualification).

(b) Acceptable Qualification Means. First-time RNP RNAV training and qualifications should be addressed during initial, transition, upgrade, recurrent, differences, or stand-alone training and qualification programs. The RNP RNAV topics may be addressed separately or integrated with other curriculum elements. For example, RNP RNAV qualification may be keyed to specific aircraft during transition, upgrade, or differences courses. RNP RNAV qualification may be addressed in conjunction with general training (e.g., during "new hire" indoctrination), and/or it may be addressed in conjunction with recurrent training or checking events (e.g., recurrent proficiency check/proficiency training (PC/PT), line-oriented flight training (LOFT)). RNP RNAV qualification may also be addressed as a separate program (e.g., by completion of a standardized RNP RNAV curriculum at an operator's training center or at designated crew bases).

(c) Credit for Use of Other Programs. Operators intending to receive credit for RNP RNAV training, when the program being proposed is based on previous experience (e.g.,

Future Air Navigation Systems (FANS) 1), or when the training is to be conducted by another operator, training center, or manufacturer, must be authorized to receive that credit from the FAA. This is necessary even though the RNP RNAV training may already be FAA-approved for the other operator, training center, or manufacturer conducting the training. Credit may be permitted for use of other operator or training center programs if the FAA has approved those programs and if aircraft, RNP RNAV systems, procedures, and other relevant factors or circumstances are the same or equivalent to those of the operator seeking credit. If there is uncertainty about the suitability of a proposed program for a particular RNP RNAV system or aircraft type, the POI may consult, through established organizational procedures, with the appropriate division of AFS, the National Simulator Evaluation Team (NSET), or the Aircraft Evaluation Group (AEG).

(2) RNP RNAV Academic Training. The following subjects should be addressed in an approved program of RNP RNAV academic training during the initial introduction of a crewmember to RNP RNAV systems. For subsequent programs, only the new, revised, or emphasized items need be addressed.

(a) General Concepts of RNP RNAV Operation. RNP RNAV academic training should cover RNP RNAV systems theory to the extent appropriate to ensure proper operational use. Flightcrews should understand basic concepts of RNP RNAV systems operations, classifications, and limitations. The training should include general knowledge and application of RNP and RNP RNAV in the National Airspace System (NAS) and other airspace as appropriate.

(b) ATS Communication and Coordination for Use of RNP RNAV. Flightcrews should be advised of proper flight plan classifications to use and any ATS separation criteria or procedures that are based on RNP RNAV use. They should receive instruction on the need to advise Air Traffic Control (ATC) immediately when the performance of the aircraft's navigation is in doubt. Flightcrews should also know what sensors are used as the basis for their RNP compliance, and be able to assess the impact on the remainder of the flight plan in the event of failure of any avionics or known loss of ground systems.

(c) RNP RNAV Equipment Components, Controls, Displays, and Alerts. Academic training should include discussion of RNP RNAV terminology, symbology, operation, optional controls, and display features including any items unique to an air carrier's implementation or system. Applicable failure alerts and limitations should also be addressed. A thorough understanding of the equipment used in RNP RNAV operations and its limitations is important.

(d) AFM Information. AFM provisions should be addressed, including information on RNP RNAV modes of operation, normal and non-normal flightcrew operating procedures, responses to failure alerts, and any AFM limitations. Training in contingency procedures in the event RNP RNAV capability is lost or degraded should also be addressed. Although this information normally originates from the AFM or AFM supplement, it may be found in the manuals approved for use by the flightcrews (e.g., Flight Operations Manual (FOM) or Pilot Operating Handbook (POH)).

(e) MEL Operating Provisions. Flightcrews should have a thorough understanding of the MEL requirements supporting RNP RNAV.

(3) RNP RNAV Procedures Training. In addition to the academic training, appropriate operational use training is required. Training programs should cover the proper use of RNP RNAV as described in the manufacturer's approved documentation. The operational training should include RNP RNAV procedures and limitations; correct assessment of displays, aural advisories, and annunciations; and timely and correct responses to RNP RNAV failures. Such training may be conducted using approved flight training devices or simulators.

(4) Initial Evaluation of RNP RNAV Knowledge and Procedures. Individual flight crewmember RNP RNAV knowledge and procedures should be evaluated prior to RNP RNAV use. As a minimum, a thorough evaluation of pilot procedures, local terrain, and specific aircraft performance requirements should be performed. Acceptable means of initial assessment include:

(a) Evaluation by an authorized instructor or check airman using an approved simulator or training device.

(b) Evaluation by an authorized instructor or check airman during line operations, training flights, PC/PT events, operating experience, route checks, and/or line checks.

(5) RNP RNAV Recurrent Training. RNP RNAV recurrent training should be integrated into and/or conducted in conjunction with other established recurrent training programs.

(6) RNP RNAV Recurrent Evaluation. Recurrent RNP RNAV checking should be incorporated as necessary, as an element of routine proficiency training or proficiency check programs.

(7) RNP RNAV Currency (Recency of Experience). Unless otherwise required, and as long as recurrent training is accomplished, specific RNP RNAV currency requirements are not necessary once flight crews have completed initial RNP RNAV training.

(8) Line Checks and Route Checks. Unless otherwise required, and as long as recurrent training is accomplished, specific RNP RNAV check requirements are not necessary once crews have completed initial RNP RNAV training.

(9) Line-Oriented Flight Training (LOFT). LOFT programs using approved simulators should incorporate RNP RNAV operations.

(10) Cockpit (or Crew) Resource Management (CRM). CRM programs should address effective teamwork in RNP RNAV operations.

(11) RNP RNAV Academic Training Methods. Appropriate methods may be suited to each air carrier's program. No special methods related to academic training for RNP RNAV are identified. Typically, a combination of ground instruction, manual information, flightcrew bulletins, and other such means to address academic topics are acceptable.

d. Part 91 Flightcrew Training. See Appendix 2 for Part 91 recommended flightcrew training.

e. Dispatch Training. Training for dispatchers should include how to determine RNP RNAV performance availability considering aircraft equipment capabilities, flightcrew qualifications, and navigation signal availability.

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APPENDIX 1. RNP RNAV APPLICATION PACKAGE FOR PART 121/135 OPERATORS

This appendix contains guidance for 121/135 operators to aid in the completion of phase two of the approval process. The guidelines listed below may not be all-inclusive.

Procedures and operating limitations, as well as equipment requirements, should be specified in the AFM.

1. AIRCRAFT ELIGIBILITY DOCUMENTATION. It is important that the aircraft eligibility determination be made early in this process. There are two types of eligible aircraft:

a. Aircraft with documentation that states that the RNP RNAV system has been certified in accordance with **(DRAFT)** AC 20-RNP, Airworthiness Approval of Required Navigation Performance. Operators that propose to conduct RNP RNAV operations should present documentation to their CMO or CHDO as evidence that their aircraft comply with the criteria defined in **(DRAFT)** AC 20-RNP. The following evidence is acceptable:

(1) Aircraft (Airplane/Rotorcraft/Powered Lift) Flight Manual stating compliance with **(DRAFT)** AC 20-RNP.

(2) Aircraft (Airplane/Rotorcraft/Powered Lift) Flight Manual Supplement stating compliance with **(DRAFT)** AC 20-RNP.

(3) Type Certificate (TC), Supplemental Type Certificate (STC), or Amended Type Certificate stating compliance with **(DRAFT)** AC 20-RNP.

(4) Flight Standardization Board (FSB) Report or other official documentation stating compliance with **(DRAFT)** AC 20-RNP.

b. Aircraft without documentation that states that the RNP RNAV system has been certified in accordance with **(DRAFT)** AC 20-RNP and do not have to be re-certified. Operators that propose to conduct RNP RNAV operations should present documentation to their CMO or CHDO that their aircraft comply with the criteria defined in **(DRAFT)** AC 20-RNP. The following evidence is acceptable:

(1) Aircraft (Airplane/Rotorcraft/Powered Lift) Flight Manual stating that the aircraft has demonstrated an RNP capability. In addition, the operator must provide a summary of compliance to the criteria defined in **(DRAFT)** AC 20-RNP. Where specific capabilities are not provided, operating procedures or limitations must be proposed to address the system deficiency.

(2) Evidence that the aircraft is equipped with TSO-C146 equipment installed in accordance with AC 20-138A.

(3) If the certificate holder or operator is not able to provide the principal inspectors with specific RNP RNAV eligibility from the AFM, AFM supplement, STC, or FSB Report, official

written equipment eligibility must be attained. A 14 CFR Part 121, 125, 129, or 135 operator should request that its CMO (IFO) or CHDO provide assistance in the eligibility assessment. The certificate holder or operator should provide the CMO (IFO) or CHDO with the RNP RNAV system make, model, and part number; any evidence of RNP RNAV approval; and pertinent information from flightcrew operating procedures.

(4) If the CMO (IFO) or CHDO is unable to determine equipment eligibility from the approved documentation, it should forward the request and supporting data through its FAA Flight Standards Regional Division to the appropriate Aircraft Evaluation Group (AEG). The AEG will verify that the aircraft and RNAV system meet the criteria for RNP RNAV operations. The AEG will provide written documentation (e.g., amended FSB Report or other official documentation) to verify the eligibility of that equipment.

Note: Airworthiness approval for RNP RNAV requires an assessment of the navigation equipment including the FGS and displays to ensure that the installed components satisfy the accuracy and airborne containment requirements. This assessment is best addressed through the STC/TC process.

2. CONTINUED AIRWORTHINESS PROGRAM. The operator should develop a maintenance program that provides instructions for continued airworthiness of the equipment/systems to be used for RNP RNAV operations.

a. The operator should provide documentation that appropriate maintenance practices and procedures have been adopted.

b. The maintenance program should identify inspection items, establish time-in-service intervals for maintenance and inspections, and provide details of the proposed methods and procedures. The maintenance program also should include instructions for continued airworthiness for the necessary calibration procedures required.

c. The operator should provide a plan for incorporating navigation software, including navigation database changes, necessary to maintain RNP RNAV compliance.

3. TRAINING. Training programs should be developed for flightcrews, maintenance personnel, and dispatch personnel as required.

> **NOTE: Ground training and flight training is required for 14 CFR Part 121 and 135 certificate holders authorized to conduct RNP RNAV operations. For 14 CFR Part 121 operations, flightcrew ground training, flight training, and flight checking must be addressed in accordance with 14 CFR Part 121, appendices E and F or the Advanced Qualification Program (AQP), as applicable.**

4. OPERATING PROCEDURES. For RNP RNAV operations, all flightcrews should be familiar with the operating procedures detailed below. The following procedures should be included in the applicable operator's required training programs.

a. Database Procedures. A current database is required for RNP RNAV operations. The RNP RNAV system must contain the waypoints (geographic locations) and associated RNP RNAV information for the procedure to be flown. If the equipment does not support the radius-to-fix (RF) leg type (see AC 20-RNP, DO-236A), the system or data process must be able to discriminate between instrument procedures it can and cannot support. For example, if a procedure uses an RF leg and/or RNP holding, but the equipment is not capable of performing an RF leg or RNP holding, procedures containing these leg types and/or RNP holding will not be available to the flightcrew. RNP holding refers to a revised holding pattern entry (see DO-236A), and continuous course guidance during the hold. Procedures must be developed to ensure the integrity of the waypoints contained in the database being used for RNP RNAV operations. RNP RNAV DPs, STARs, and IAPs must be retrieved from the current database, and modification of these procedures is not authorized. Storage of user-defined waypoints is permitted within the equipment. Data uploading/updating verification procedures should also be addressed.

b. Predictive Capability. A predictive capability is required which will forecast whether RNP RNAV of a specified type will be available at the time and location of a desired RNP RNAV operation accounting for known and predicted outages of NAVAIDS or other sensors used by the system. This capability is not required to be resident in the avionics equipment itself, but could be a ground service. Procedures must be established that use this capability as a pre-flight dispatch or flight following function to ensure that the equipment will be able to provide the desired level of RNP RNAV throughout the entire flight. This capability must consider the specific combination of aircraft capability (sensors and integration) and available infrastructure (e.g., ground based navigation aids or approval to use GNSS). In addition, the flightcrew must have the means to identify facilities that are not expected to be available, e.g., excluding the use of NOTAMed navigation facilities.

c. System Performance. When operating in an RNP RNAV environment, the RNP RNAV type for the area, route, or procedure will be specified. In some cases, RNP type specification may be accomplished without pilot interaction through database coding or some other means. In such cases, the pilot may only receive an "RNP unable" alert when the aircraft equipment is not able to achieve the required RNP RNAV type for the area or procedure. In other cases, the pilot may have to ascertain that the aircraft navigation equipment is operating in the correct mode for the required RNP RNAV type. For example, an RNAV approach authorized for GNSS or Distance Measuring Equipment/Inertial Reference Unit (DME/DME/IRU (D/D/I)) shall require verification of the navigation mode if other modes are allowed by the navigation equipment (e.g., Very High Frequency Omni-directional Range/Distance Measuring Equipment (VOR/DME)). Specifically, only authorized sensors are used to conduct RNP RNAV operations. If the equipment does not have the capability to select the RNP RNAV type or does not support non-standard RNP RNAV types, then the system must include a capability to discriminate between RNP RNAV procedures it can and cannot support. For example, if an RNP RNAV procedure uses an RNP-0.3 RNAV missed approach segment, but the system does not support non-standard RNP RNAV leg types, the pilot should not be able to access or use the procedure (since the default RNP RNAV type in the terminal area is RNP-1.0 RNAV).

d. Enhanced Navigation Displays. An enhanced navigation display (such as an electronic moving map or enhanced HSI) may be desirable to improve situational awareness and monitor navigation performance. User assessment of navigation performance and situational awareness may be achieved by an integrated presentation of a flight plan, map ranges consistent with the flight operation and/or RNP RNAV, available navigation aids, and airports on a graphical map display. The use of out-of-date navigation data on enhanced navigation displays is not acceptable.

e. NAVAID Exclusion. Procedures to determine and exclude NAVAID facilities identified as out-of-service need to be addressed. Requirements are contained in AC 20-RNP.

Note: If a DME facility requires maintenance, ATS providers will NOTAM the facility out-of-service and may remove the facility's IDENT feature. However, the facility may still transmit a DME signal and respond to interrogations. This DME signal may or may not be accurate and must not be used.

f. Critical DME Reception for RNP RNAV Systems using DME. An operator shall not commence an approach if the minimum set of defined critical DMEs is not available.

g. Course Deviation Indicator (CDI). The AFM(s) should state which RNP RNAV types and operations the aircraft supports and the operational effects on the CDI scale. The CDI full-scale deflection value shall be known or available for display to the flight crew. If the flight crew can manually select the CDI scale, procedures must be established to assure CDI scale is appropriate for the intended RNP RNAV operation. An auto-slewable CDI is required for manually flown RF leg capability.

h. Contingency Procedures. Contingency procedures will need to be developed by the operator to address the following conditions:

(1) Failure of the RNP RNAV system components, including those affecting flight technical error (e.g., failures of the flight director or automatic pilot). Some aircraft require the autopilot to be used to achieve a certain RNP level. Procedures should be in place for an alternate course of action if this type of failure occurs.

(2) Failure of the navigation sensors. If a navigation sensor becomes inoperative, the RNP RNAV system may not be able to achieve the required RNP level. The flight crew must be able to assess the impact of equipment failure on the remainder of the flight plan and take appropriate action. Procedures should be in place for an alternate course of action if this occurs.

(3) Loss of signal-in-space (loss or degradation of external signal). When the loss or degradation of an external signal decreases the performance of an RNP RNAV system below the required RNP level the procedure should be discontinued. The flight crew must be able to assess the impact of ground navaid failure on the remainder of the flight plan and take appropriate action. Procedures should be in place for an alternate course of action if this occurs.

(4) Coasting on inertial sensors beyond a specified time limit. Upon loss of auto-updates or loss of GPS coupling of an IRU, an IRU will navigate using inertial guidance only. In this mode, the inherent drift of the IRU will continuously degrade the navigation solution offered by

the IRU. Thus, operations relying on an IRU "coasting" using inertial guidance exclusively can only continue for a specified amount of time before the navigation solution offered by the IRU exceeds the containment region and a loss of RNP RNAV navigation capability occurs. In essence, IRUs "coasting" under these conditions can provide limited support for RNP RNAV. As a result, contingency procedures must reflect the length of time an IRU is capable of supporting the various levels of RNP RNAV.

5. MANUAL REVISIONS. The operator should submit revisions to applicable company manuals for acceptance or approval.

6. MINIMUM EQUIPMENT LIST. The operator should submit revisions to the MEL necessary for the conduct of RNP RNAV operations.

7. VALIDATION TEST PLAN. The operator should develop a validation plan in conjunction with the guidance contained in Order 8400.10, chapter 9.

APPENDIX 2. OPERATIONAL APPROVAL FOR RNP RNAV OPERATIONS FOR PART 91 OPERATORS

Operators under 14 CFR Part 91 must meet the requirements of section 91.3 and must ensure that RNP RNAV operations are conducted in accordance with this AC.

1. AIRCRAFT ELIGIBILITY.

Aircraft system eligibility for RNP RNAV operations is based on an Airplane Flight Manual (AFM) or AFM supplement entry stating the equipment is certified for RNP RNAV operations under **(DRAFT)** AC 20-RNP. If you believe that your system is capable of RNP RNAV operations and the AFM or supplement does not include certification for RNP RNAV operations under **(DRAFT)** AC 20-RNP, contact your FSDO to determine what is required to obtain the certification statement in your AFM or supplement. (Refer to Appendix 1 for additional guidance on aircraft eligibility documentation.)

The AFM or supplement will contain any limitations associated with the operation of your RNP RNAV equipment. This will include the types of RNP RNAV, equipment configuration requirements, and any operational constraints or requirements for RNP RNAV.

For terminal and approach operations, RNP RNAV requires a navigation database for IFR flight operations. The pilot in command must ensure the data is current.

2. AUTHORIZED RNP RNAV OPERATIONS INCLUDE TERMINAL AREA OPERATIONS. These operations require the RNP RNAV equipment to be in terminal (RNP-1 RNAV) operations mode. Where RNP-1 RNAV is designated, TSO-C146 equipment must be in terminal mode. Refer to the AFM or pilot's operating manual.

a. RNAV Departure Procedures (DP). DPs must be retrieved as a procedure from the navigation database. Retrieving individual waypoints comprising the DP, for the purpose of executing the procedure, is not authorized. Some RNP RNAV equipment may require position updating prior to flying the procedure; refer to AFM limitations. Only equipment certified for RNAV DPs will retreive DPs from the navigation database.

b. RNAV STARs. RNAV STARs must be retrieved as a procedure from the navigation database. Retrieving individual waypoints comprising the STAR, for the purpose of executing the procedure, is not authorized. Only equipment certified for RNAV STARs will retreive STARs from the navigation database.

c. RNAV Instrument Approach Procedures (IAP). RNAV IAPs must be retrieved as a procedure from the navigation database. Retrieving individual waypoints comprising the IAP, for the purpose of executing the procedure, is not authorized. Only RNP RNAV equipment certified for instrument approach operations will retrieve IAPs from the navigation database. Present RNAV IAPs which may be flown with RNP RNAV systems include GPS approaches and LNAV minima on RNV (GPS) approaches. These approaches require RNP-0.3 RNAV based on GPS senosrs. THE LNAV minima on RNAV (GPS) IAPs may be flown by DME/DME/Inertial RNP –0.3 RNAV systems unless the procedure is annotated "DME/DME

RNP 0.3 NA." If DME/DME/Inertial is authoirzed, critical DME's may be identified for which operations should not be predicated on the procedure if a critical DME is NOTAMed out of service.

d. VNAV Approach Operations. RNP RNAV systems certified for instrument approach operations may be used to provide lateral guidance for VNAV instrument approach operations conducted in accordance with AC 90-97. VNAV approaches which may be flown with RNP RNAV systems with AC 90-97 VNAV are the LNAV/VNAV minimum on RNAV (GPS) IAPs. These may be flown by DME/DME/Inertial RNP-0.3 RNAV systems unless the procedure is annotated "DME/DME RNP 0.3 NA."

3. OPERATING PROCEDURES. For RNP RNAV operations, flightcrews should be familiar with the operating procedures detailed below. These procedures should be included in training programs.

a. Database Procedures. Current data is required for RNP RNAV operations. The RNP RNAV system must contain the waypoints and associated RNP RNAV information for the procedure to be flown. If the equipment does not support specific RNP RNAV capabilities, the system will not retrieve instrument procedures it cannot support. For example, if a procedure uses an RF leg and/or RNP holding, but the equipment is not capable of performing an RF leg or RNP holding, procedures containing these leg types and/or RNP holding will not be available to the flightcrew. RNP RNAV DPs, STARs, and IAPs must be retrieved from the current database, and modification of these procedures is not authorized. Storage of user-defined waypoints is permitted within the equipment. Operators must be familiar with data uploading/updating verification procedures. Paper and/or electronic charts should be available to the flight crew to mitigate any discrepancies or missing data in the database.

b. Pre-Flight. A predictive capability is required for RNP RNAV equipment that will forecast whether RNP RNAV of a specified type will be available at the time and location of a desired RNP RNAV operation. This capability is not required to be resident in the avionics equipment itself, but could be a ground service. This capability must consider the specific combination of aircraft capability (sensors and integration) and available infrastructure (e.g., ground based navigation aids or approval to use GNSS). Prior to IFR flight using an RNP RNAV system, the pilot must use this predictive capability to determine whether the RNP RNAV requirements of the proposed flight can be met by the RNP RNAV equipment, accounting for known and predicted outages of NAVIDS or other sensors used by the system. If additional equipment (e.g., autopilot) is required by the AFM or supplement to meet any RNP RNAV type for the proposed flight, that equipment must be operational.

c. System Performance. When operating in an RNP RNAV environment, the RNP RNAV type for the area, route, or procedure will be specified. In some cases, RNP type specification may be accomplished without pilot interaction through database coding or some other means. In such cases, the pilot may only receive an "RNP unable" alert when the aircraft equipment is not able to achieve the required RNP RNAV type for the area or procedure. In other cases, the pilot may have to ascertain that the aircraft navigation equipment is operating in the correct mode for the required RNP RNAV type. For example, an RNAV approach authorized for GNSS or Distance Measuring Equipment/Inertial Reference Unit (DME/DME/IRU (D/D/I)) shall require

verification of the navigation mode if other modes are allowed by the navigation equipment (e.g., Very High Frequency Omni-directional Range/Distance Measuring Equipment (VOR/DME)). Specifically, only authorized sensors are used to conduct RNP RNAV operations. If the equipment does not have the capability to select the RNP RNAV type or does not support non-standard RNP RNAV types, then the system must include a capability to discriminate between RNP RNAV procedures it can and cannot support. For example, if an RNP RNAV procedure uses an RNP-0.3 RNAV missed approach segment, but the system does not support non-standard RNP RNAV leg types, the pilot will not be able to access or use the procedure (since the default RNP RNAV type in the terminal area is RNP-1.0 RNAV).

d. Enhanced Navigation Displays. An enhanced navigation display (such as an electronic moving map or enhanced HSI) may be desirable to improve situational awareness and monitor navigation performance. User assessment of navigation performance and situational awareness may be achieved by an integrated presentation of a flight plan, map ranges consistent with the flight operation and/or RNP RNAV, available navigation aids, and airports on a graphical map display.

e. NAVAID Exclusion. Procedures to determine and exclude NAVAID facilities identified as out-of-service need to be addressed. Requirements are contained in AC 20-RNP. The pilot must exclude NOTAMed facilities during use of the predictive capability of the equipment for preflight planning and must inhibit the use of this NAVAID by the RNP RNAV equipment during IFR flight.

Note: If a DME facility requires maintenance, ATS providers will NOTAM the facility out-of-service and may remove the facility's IDENT feature. However, the facility may still transmit a DME signal and respond to interrogations. This DME signal may or may not be accurate and must not be used.

f. Critical DME Reception for RNP RNAV Systems using DME. An operator shall not commence an approach if the minimum set of defined critical DMEs is not available.

g. Course Deviation Indicator (CDI). The AFM(s) should state which RNP RNAV types and operations the aircraft supports and the operational effects on the CDI scale. The CDI full-scale deflection value shall be known or available for display to the flight crew. If the flight crew can manually select the CDI scale, procedures must be established to assure CDI scale is appropriate for the intended RNP RNAV operation. An auto-slewable CDI is required for manually flown RF leg capability.

4. CONTINGENCY PROCEDURES. If the system announces that it is unable to meet the required RNP RNAV type during IFR RNP RNAV operations, the pilot must be prepared to abort the operation and use other navigation systems to safely complete the flight. Some aircraft require the autopilot to be used to achieve a certain RNP level; hence, an alternate plan or procedure may be required if the autopilot is inoperative.

5. FLIGHTCREW TRAINING.

a. Although no regulation specifically requires Part 91 operators to receive training in RNP RNAV operations, 14 CFR section 91.103 requires that each pilot in command, before beginning a flight, become familiar with all available information concerning that flight. Also, 14 CFR section 91.205(d) requires that the aircraft be equipped with appropriate communication and navigation equipment. Consequently, if a pilot is going to use RNP RNAV and fly in RNP RNAV airspace, then that pilot must have knowledge of the RNP RNAV equipment, airspace, and procedures. This knowledge can only be obtained with some training.

b. The POH, AFM, and/or AFM supplement should contain the installed RNP RNAV systems description, operational procedures, and emergency procedures. This may give the pilot information on the equipment's approval level, authorizations, and limitations. But there is more to RNP RNAV operations than being familiar with the equipment in the aircraft. The FAA recommends that Part 91 operators take operational and practical training on RNP RNAV from an authorized flight instructor. The RNP RNAV training program for flightcrews should include, but is not limited to:

(1) General knowledge and application of RNP and RNP RNAV in the NAS and other airspace as appropriate.

(2) A thorough understanding of the equipment used in RNP RNAV operations and its limitations.

(3) Operating procedures and safeguards necessary to maintain the required navigational performance.

(4) Ground and flight training on equipment and procedures.

(5) The need to advise ATC immediately when the performance of the aircraft's navigation is in doubt.

(6) Training in contingency procedures in the event RNP and RNP RNAV capability is lost or degraded.

c. Additionally, the subject and knowledge areas should be similar to the RNP RNAV academic training, and RNP RNAV procedures training as listed under Section 7 c., "Part 121 & 135 Flightcrew Qualification Training", of this AC.

APPENDIX 3: OPERATIONAL APPROVAL FOR PROCEDURES REQUIRING SPECIAL AIRCREW AND AIRCRAFT AUTHORIZATION OTHER THAN SPECIALS

1. **Background.** Standard RNP RNAV IAP obstruction clearance areas rely on aircraft certification of RNP RNAV capability under AC 20-RNP (DRAFT). The probability of exceeding the obstruction clearance area during the conduct of an RNP-RNAV procedure shall be less than 1×10^{-9} . The FAA will provide IAPs with RNP RNAV minimums labeled "**SPECIAL AIRCREW AND AIRCRAFT AUTHORIZATION REQUIRED**" that will have reduced obstruction clearance areas. Use of these minimums may require a combination of aircraft equipment beyond the equipage required by AC 20-RNP along with training, operational procedures and constraints to maintain the requisite target level of safety despite a reduced obstruction clearance area.. FAA Flight Standards personnel shall determine whether or not the additional equipage, training, operational procedures and constraints provide an equivalent level of safety and mitigate the additional risk of reducing the obstruction clearance area for a special procedure when the impact of these applications cannot be conveniently modeled to determine an impact on the achieved level of safety. To be authorized to use **SPECIAL AIRCREW AND AIRCRAFT AUTHORIZATION REQUIRED** RNP RNAV minimums, operators under 14 CFR Parts 121, 125, 129 and 135 must obtain appropriate authorization through their CMO(IFO) or CHDO and those under Part 91 must obtain authorization from their FSDO.

2. **Aircraft Requirements.**

   a. The aircraft must have dual RNP RNAV avionics that meet hazard level associated with the proposed operation/procedure.

   b. The RNP RNAV avionics must incorporate dual IRUs and dual FMCs.

   c. The RNP RNAV avionics must be based on GPS. Multi-sensor equipment must have the capability of inhibiting ground-based NAVAID updating.

   d. The aircraft must have a flight director or autopilot certified for instrument approach.

   e. The aircraft must have other systems installed and operational e.g., EGPWS or TAWS system with a current database, that provide the requisite risk mitigation not accounted for by the navigation systems.

3. **Operational Procedures.**

   a. A RAIM prediction must be accomplished during dispatch that indicates that the requisite RNP RNAV performance based on GPS will be available during the period one hour prior to one hour after the planned approach period.

b. The IAP must be flown using the flight director or coupled.

c. The EGPWS or TAWS must be operational during the IAP.

d. The avionics must be set to inhibit the use of ground based navaids.

e. Flight crews must receive training to cover as a minimum:

(1) General knowledge and application of RNP RNAV.

(2) A thorough understanding of the equipment required for RNP RNAV operations and its limitations.

(3) Operating procedures and safeguards necessary to maintain the required navigational performance.

(4) Training in contingency procedures in the event RNP RNAV capability is lost.